

Earth Entry Vehicle Impact Analysis

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ABSTRACT

Analyses were performed on the Multi-Mission Earth Entry Vehicle (MMEEV), which uses a foam absorber to safely return payload to Earth. Using both analytical and computational approaches, these analyses investigate two performance metrics – stroke length and payload acceleration. Analytical analyses involved deriving fundamental relationships between loading, stroke, impact velocity, and material properties from first principles. These equations, which simplified complex behavior, provided a broader view of the performance space. Performance metrics were analyzed computationally using the finite element solver LS-DYNA. Parameters such as impact velocity, soil properties, and geometry were varied in order to gauge their influence on the impact performance metrics. Results were compared between a two-dimensional rigid surface and a three dimensional soil model. Initial results showed that the rigid surface was conservative by 40% - 60%. The majority of inputs for the finite element model came from similar analyses done for Mars Sample Return. However, when data was unavailable, engineering judgment was used to estimate the unknown information and a sensitivity analysis was performed around that estimate. The goal of this work is to generate parametric relationships that will permit rapid performance analysis of energy absorbing systems. Response surface equations are created by regressing finite element data against known quantities and parameters derived from first principles.